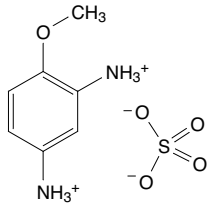
2,4-Diaminoanisole Sulfate

CAS No. 39156-41-7

Reasonably anticipated to be a human carcinogen

First listed in the *Third Annual Report on Carcinogens* (1983)



Carcinogenicity

2,4-Diaminoanisole sulfate is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

Oral exposure to 2,4-diaminoanisole sulfate caused thyroid-gland tumors in mice and rats, as well as tumors at several other tissue sites in rats. Dietary administration of 2,4-diaminoanisole sulfate caused thyroid-gland cancer (follicular-cell carcinoma or papillary adenocarcinoma or cystadenocarcinoma) in rats of both sexes and increased the combined incidence of benign and malignant C-cell tumors of the thyroid gland (adenoma and carcinoma) in male rats. In mice, it increased the combined incidence of benign and malignant thyroid-gland tumors (follicular-cell adenoma and carcinoma) in females and benign thyroid-gland tumors (follicular-cell adenoma) in males. Dietary administration of 2,4-diaminoanisole sulfate also caused cancer of the Zymbal gland (squamous-cell carcinoma or sebaceous adenocarcinoma) in rats of both sexes. In male rats, it also caused cancer of the skin (squamous- or basal-cell carcinoma or sebaceous adenocarcinoma) and increased the combined incidence of benign and malignant tumors of the preputial gland (adenoma, papilloma, and carcinoma). In female rats, it also caused cancer of the clitoral gland (squamous- or sebaceous-cell carcinoma) and the mammary gland (adenocarcinoma); these animals also developed tumors of the pituitary gland (IARC 1978, 1982, NCI 1978).

Cancer Studies in Humans

No epidemiological studies were identified that evaluated the relationship between human cancer and exposure specifically to 2,4-diaminoanisole sulfate. Epidemiological studies have been conducted on professional and personal users of hair dyes; however, none of these studies specifically mentioned possible exposure to 2,4-diaminoanisole sulfate (IARC 2001).

Properties

2,4-Diaminoanisole sulfate is an aromatic amine salt that is an off-white to violet powder at room temperature (IARC 1978, 1982). It is soluble in water and ethanol and insoluble in sodium hydroxide. Physical and chemical properties of 2,4-diaminoanisole sulfate are listed in the following table.

Property	Information
Molecular weight	236.3[a]
Melting point	66°C to 67°C[b]
Boiling point	149°C to 150°C at 5 mm Hg[b]
Log K_{ow}	4.19[c]
Water solubility	1,000 g/L at 25°C[c]
Vapor pressure	1.05×10^{-14} mm Hg[c]

Sources: [a]HSDB 2009, [b]Akron 2009, [c]ChemIDplus 2009.

Use

2,4-Diaminoanisole sulfate has been used primarily as a component of oxidizing "permanent" hair- and fur-dye formulations. In 1978, about 75% of hair-dye formulations contained 2,4-diaminoanisole or its sulfate. However, a U.S. regulation requiring a warning label on all hair dyes containing 2,4-diaminoanisole or its sulfate was to become effective in April 1980, and the chemicals were voluntarily removed from products before that time (IARC 1982). 2,4-Diaminoanisole also has been used as an intermediate in the production of C.I. basic brown 2, which has been used to dye furs, acrylic fibers, cotton, wool, nylon, polyester, leather, and suede and has been an ingredient of shoe polishes (IARC 1978, 1982).

Production

Commercial production of 2,4-diaminoanisole sulfate in the United States was first reported in 1967, but no production has been reported since 1971 (IARC 1978). In 1977, annual usage of 2,4-diaminoanisole sulfate in the United States was estimated at 30,000 lb (NCI 1978). No data were found regarding U.S. production, imports, or exports of 2,4-diaminoanisole sulfate after its voluntary removal from hair dyes. In 2009, 2,4-diaminoanisole sulfate was produced by one manufacturer (in Europe) (SRI 2009) and was available from seven suppliers worldwide, including four U.S. suppliers (ChemSources 2009).

Exposure

The primary routes of potential human exposure to 2,4-diaminoanisole sulfate are dermal contact and inhalation. Consumers who used hair dyes containing 2,4-diaminoanisole sulfate could have been exposed. In 1973, it was estimated that 40% of U.S. women were regular users of hair dyes. Most of the dyes used were of the permanent type, and certain of these products used 2,4-diaminoanisole sulfate as a color modifier. Before its removal from consumer products, the maximum concentration of 2,4-diaminoanisole sulfate in concentrated hair-dye preparations was approximately 1.5%. Therefore, substantial exposure of the general population to 2,4-diaminoanisole sulfate was possible (NCI 1978). No releases of 2,4-diaminoanisole sulfate to the environment were reported in the U.S. Environmental Protection Agency's Toxics Release Inventory from 1988 to 2007; however, small amounts of 2,4-diaminoanisole were released to air in 1989 (250 lb) and 1990 (26 lb) (TRI 2009). Occupational exposure could have occurred among workers at chemical- and dye-production facilities and workers using dyes containing 2,4-diaminoanisole sulfate to dye furs, textiles, and leather. Hairdressers and cosmetologists could have been exposed through the use of hair dyes containing 2,4-diaminoanisole sulfate (NCI 1978).

Regulations

Environmental Protection Agency (EPA)

Emergency Planning and Community Right-To-Know Act

Toxics Release Inventory: Listed substance subject to reporting requirements.

Food and Drug Administration (FDA)

Hair dyes containing 2,4-diaminoanisole sulfate must contain a warning statement that the product contains an ingredient that can penetrate skin and has been determined to cause cancer in laboratory animals.

Guidelines

National Institute for Occupational Safety and Health (NIOSH)

Recommended exposure limit (REL) for 2,4-diaminoanisole and its salts = minimize occupational exposure (especially skin exposures).

2,4-Diaminoanisole and its salts are listed as a potential occupational carcinogens.

References

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TRI. 2009. *TRI Explorer Chemical Report*. U.S. Environmental Protection Agency. Last updated: 3/19/09. http://www.epa.gov/triexplorer and select 2,4-Diaminoanisole sulfate.